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Inland observations of Barau's Petrel *Pterodroma baraui* on Reunion

by M. de L. Brooke

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Barau's Petrel *Pterodroma baraui* was first described by Jouanin (1963). Since then several specimens have been collected and many seen, and the available information on the species' biology was summarised by Jouanin & Gill (1967). These authors considered *P. baraui* to belong to the group of tropical petrels included in the polytypic species *Pterodroma hasitata.* Only one nest has ever been found, not on Réunion, the type locality, but on Rodrigues (Cheke 1974). This note describes further observations on the species in the Cirque de Cilaos, Réunion, made daily 15–23 January 1974 and, in particular, comments on the diurnal activity pattern at a time when most breeding birds are likely to be incubating eggs.

Study area, weather and methods

Réunion, a volcanic island of extremely rugged topography, is roughly elliptical in shape, about 70 km long from northwest to southeast and about 50 km from northeast to southwest. The Cirque de Cilaos (*c.* 21° 7′ S, 55° 29′ E) is slightly west of centre and approximately 25 km from the southwest coast. It is from the west and southwest coasts that most Barau's Petrels apparently leave the sea en route to their inland nesting grounds (Jouanin & Gill 1967). The contoured map (Fig. 1) indicates the large size of the walls of the Cirque, which become steeper with altitude so that cliffs up to 800 m in height drop down from the major summits such as the Piton des Neiges. The height of the woodland canopy is about 10 m at 1000 m decreasing to 4 m at 2400 m and then low scrub, with the steepest cliffs bare.

Map of the Cirque de Cilaos, Réunion, showing sites (1–6) from which Barau's Petrels *Pterodroma baraui* were observed during January 1974.

During the observation period the daily weather cycle was well-marked and fairly constant. Following a clear night and dawn, cloud built up from 10.00 (all times refer to local time) and, during the afternoon, virtually all areas between 1800 m and 3000 m were in cloud. In the late afternoon strong air currents flowed up the walls off the Cirque so that by 20.30, in the afterglow period, the Cirque and surrounding mountains were once more clear of cloud except for occasional patches below 2000 m which dispersed during the night. I am informed (in litt.) by the *Ingenieur en Chef de la Meteorologie* at the *Ministere des Transports*, St. Denis, that such a pattern is characteristic of non-cyclonic periods on Réunion.

Observations were made on 9 consecutive evenings, once throughout the night and on 4 mornings (Table 1). Sunrise and sunset were at about 06.40 and 20.10 respectively. At the eastern side of the Cirque, where most watches were done, there was complete darkness from about 20.45 to 06.15.

TABLE 1

Details of observations on Barau's Petrel *Pterodroma baraui* in the Cirque de Cilaos, Réunion, during January 1974

Date	*Site (Altitude, m)*	*Period of observation*	*P. baraui first seen (evening only)*	*Total no. seen (minimum estimate)*	*P. baraui last heard (morning only)*
15 Jan.	1 (1450)	18.00–20.05	19.10	30	
16	1	06.20–07.00			None heard
16	1	18.30–20.15	18.30	70	
17	2 (2600)	17.30–20.15	18.00	50	
18	2	05.15–06.15			06.05
18	2	17.15–21.15	18.30	120	
19	3 (2900)	17.30–20.00	19.15	5	
19	2	20.30–20.45	—	30	
20	2	18.00–22.45	19.25	50	
20/21		Then for 5 mins at approx. hourly intervals through night, until dawn			*
21	4 (1950)	18.10–20.25	18.45	100	
22	5 (2080)	18.00–21.00	18.40	25	
23	5	04.30			
23	5	05.30–06.30			06.20
23	6 (1200)	18.30–20.40	18.45	25	

*No time is given here since wind (see text) greatly obscured calling.

Observations

Observations were made mostly from the east side of the Cirque, and a few from the Col du Taibit (Site 5), which are mentioned separately. The first petrels of the evening appeared well before dusk (Table 1), as recorded in November by Jouanin & Gill (1967). Those seen from Sites 1 and 6 were directly overhead and usually flying in the direction of the Piton des Neiges at an estimated altitude of 1800–2000 m. It was not possible to be certain from which direction they arrived since most were seen only briefly through a temporary break in the clouds. At 2000 m the greatest activity occurred around 19.00, after which the greatest activity was at increasing altitude. To gain height the petrels circled like a raptor, several wing-beats alternating with gliding, exploiting the air currents sweeping up the sides of the Cirque. The strength of these currents could only be estimated by watching the rate at which a cloud boundary moved up the side of the Cirque and by 'feeling' the strength of the wind. I estimated that the vertical component of these currents might be 15 km/hr^{-1}.

At 20.15 Barau's Petrels were seen and heard to be concentrated between 2400 m and 2700 m, and the watches at Sites 4 and 5 established that none was calling below 2000 m. This was the period of greatest activity, with up to 70 birds visible simultaneously silhouetted against the sky over the ridge running southwestwards from the Piton des Neiges. The number of petrels I saw was therefore somewhat larger than the number recorded by Jouanin & Gill (1967). Other petrels, possibly a similar number, were audible between the ridge and Site 2, but being close to the cliff were rarely visible in the fading light and none was ever seen to land on the cliffs. After 20.15 no petrels were heard immediately to the south of Site 2. However the regularity

with which 50 or more gathered over the southwestern ridge of the Piton suggests that this area holds a breeding colony. Possible nesting sites would be the vegetated ledges on the cliffs immediately to the southwest of the Piton. Such sites would be secure from the feral rats and cats present in the area.

Some petrels were seen flying beyond the west ridge towards the Gros Morne where there are also large cliffs. During the evening watch at Site 5 (Col du Taibit) the cloud did not clear until after dark but the intensity of calling was similar to that heard from Site 2 and the large cliffs of the Grand Benard may hold a breeding colony.

From about 20.45 the amount of calling declined steadily. On 20 January when observation stopped at 22.45 the last call was heard at 22.15 and the last bird flew overhead at 22.25. There is apparently little, if any, calling through the middle hours of darkness. It was unfortunate that during the overnight watch, 20–21 January, a fresh southeast wind sprang up after midnight which would have drowned faint calls. However no calling was heard at 04.30 on 23 January. Calling recurred from 05.15 or somewhat before, intensifying until 05.45–06.00, at which time some petrels were flying. As in the evening, calling was most intense around 2500 m. Calling subsided rapidly and was finished by about 06.15, after which time no petrels were seen or heard.

Discussion

This account of inland activity agrees reasonably with observations at the coast in November (Jouanin & Gill 1967, A. S. Cheke pers. comm.). Birds began to fly inland from the coast at about 16.30 and continued to do so in an ever-increasing stream until, at about 19.00, it was too dark to see. Thus the last birds seen leaving the coast before dark would be arriving at the presumed colony at the times inland observations suggest, although there is no knowing whether the flow of petrels continues inland after dark. Some petrels near the coast circled to gain height like those climbing the Cirque de Cilaos. There are no dawn observations at the coast.

Barau's Petrel is unusual among *Pterodroma* species in combining high altitude nesting with a crepuscular pattern of activity at the colony. The altitude of the presumed breeding colonies on Réunion is around 2500 m, although former colonies may have been somewhat lower (see Jouanin & Gill 1967 for historical details), and it nests at only 320 m on Rodrigues (A. S. Cheke pers. comm.). By arriving inland well before dark, Barau's Petrel is able to circle in the air currents sweeping up the sides of the Cirque de Cilaos and thus reduce the energy cost of the ascent to the colony. These currents are at their strongest as the light fades in the early evening. Estimates were made of the possible energy saving between the two extreme instances

(i) where all climbing is done in up-currents with wings held in place by tonic muscles and all horizontal distance from the coast to the presumed colony is covered by downhill gliding; and

(ii) where all climbing and horizontal progress is achieved by powered flight at the minimum power speed.

The following constants are assumed; mass 400 gm (unpublished data on adult *P. arminjoniana* and juvenile *P. baraui* provided by A. S. Cheke), wing

span 0·9 m (Greenewalt 1962, Jouanin & Gill 1967), lift/drag ratio of 20:1 (*cf.* 24·1 in albatrosses—Pennycuick 1972) and gliding speed 15 m/sec^{-1} (Pennycuick 1969). The horizontal and vertical distances to be covered are 25 km and 2·5 km respectively and the rate of climb achieved when soaring is taken to be 150 m/min^{-1}. Basal metabolism was worked out from formulae given in Marshall (1961). Using the aerodynamic assumptions and equations of Pennycuick (1969, 1972) the total energy expended in reaching the colony from the coast in the two situations is (i) 12 KJ and (ii) 135 KJ. The latter figure does not include basal metabolism since excess heat from the flight muscles is probably available during powered flight. Assuming 1 gm of fat yields 38 KJ of energy, then the fat equivalent utilised in the first situation is 0·32 gm and is 3·6 gm in the second. Since the two calculations estimate the extremes of energy required to reach the colony, in practice energy expenditure is likely to be between the two. Nevertheless, the saving due to gliding, when compounded over the many journeys made to the colony during a breeding season, appears large enough to favour the late afternoon arrival at the colony, when up currents are maximum, if this does not conflict with other demands on the birds' time.

The dusk arrival of Barau's Petrels could have a further advantage if, as has been suggested for other tubinares, particularly those feeding on squid, Barau's Petrel feeds either by night or immediately before dawn (Murphy 1936, Ashmole & Ashmole 1967, Imber 1973). After displaying at dusk, non-breeding birds would have time to travel a considerable distance to sea and feed during what may be the optimal period. Breeding adults may possibly remain paired in their burrows overnight and the departure of one bird of the pair would then account for the short period of pre-dawn calling, when the intensity of calling is much lower than at dusk. Warham (1956) noted that in the Great-winged Petrel *Pterodroma macroptera* members of the pair usually stay together for several hours during incubation changeovers, as do some Trindade Petrel *P. arminjoniana* pairs at Round Island (A. S. Cheke pers. comm.). In mid-January most pairs of Barau's Petrel are likely to be incubating and may behave similarly.

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The Cambridge collection of Fijian and Tongan landbirds

by Dick Watling

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In the Cambridge University Zoology Museum there is a little known collection of 140 skins of 42 species or subspecies of Fijian and Tongan landbirds, containing several very interesting skins. The collection has been undeservedly overlooked, probably because its existence has not been the subject of any published report. The majority of the skins were collected by Baron Anatole von Hügel, the renowned anthropologist, in 1875, material being obtained from most of the main islands. The other major contributor was L. Wiglesworth, who collected at the turn of the century. J. Lister collected most of the Tongan skins in 1889.

Von Hügel's most significant contribution was the skin of the Barred Rail *Nesoclopeus poecilopterus*, which he collected on Ovalau, a small island close to Viti Levu, although he did most of his ornitholological work on the latter island. The species has not been positively recorded this century, although possibly re-sighted in 1973 (Holyoak, in prep.). The introduction of the Mongoose *Herpestes auropunctatus* in 1883 has been responsible for the present demise of ground-living birds on the islands of Viti Levu and Vanua Levu where it is at present established. Von Hügel recorded on the label of *N. poecilopterus* 'scarce, very difficult to procure', indicating that it might already have been uncommon prior to the introduction of the mongoose; whereas Layard (1875) described it as '. . . generally distributed'. Von Hügel collected specimens of two other rails, but surprisingly not *Gallirallus phillipensis sethsmithi*, which is the most widespread of the rails in Fiji today. In 1901, Wiglesworth procured no rails at all.

Von Hügel collected two specimens of *Vitia ruficapilla ruficapilla* from the island of Kadavu, which C. W. Benson considers are possibly type material. Another interesting specimen from Kadavu is the Fiji Shrikebill *Clytorhynchus vitiensis compressirostris*, an isolated form slightly larger than other subspecies. There is also a single specimen of the rarely collected form *C. v. heinii* from Tongatapu, Tonga.

Both von Hügel and Wiglesworth collected several specimens of the Red-breasted Musk Parrot *Prosopeia tabuensis splendens* from several localities on Viti Levu, suggesting that it was then widespread and common there. This parrot was an aboriginal or early post-European introduction to Viti Levu from the island of Kadavu, where this form is endemic. Initially it